WHAT IS CLAIMED IS:

1. A system for non-invasive stoichiometric detection and imaging of chemical elements and compounds in a material to be analyzed, the system comprising:

a particle generator, the particle generator generating a plurality of first subatomic particles and a plurality of second subatomic particles at a target position which is a first distance from the material to be analyzed;

at least one photon detector, the at least one photon detector being capable of detecting photons resulting from irradiation of the material to be analyzed by the first subatomic particles and generating a plurality of first electrical signals;

a particle detector array comprising a plurality of particle detectors, the detector array at a second distance from the target position, the second distance being larger than the first distance, the particle detectors each being capable of detecting at least one second subatomic particle from the particle generator, and generating a plurality of second electrical signals; and

an analyzer operatively connected to the particle detector array and the at least one photon detector, comprising:

a processor, the processor filtering the plurality of first electrical signals so as to produce a plurality of filtered electrical signals; and

a plurality of electronic coincidence circuits, the coincidence circuits detecting coincidences occurring between the plurality of filtered electrical signals and the plurality of second electrical signals.

2. The system of Claim 1, wherein the first subatomic particles comprise neutrons.

3. The system of Claim 1, wherein the second subatomic particles comprise alpha particles.

4. The system of Claim 1, wherein the particle detectors are electronically coordinated to produce a three dimensional electronic image of the material to be analyzed, the image corresponding to a plurality of imaged volume elements, whereby the image provides an average empirical chemical formula for each imaged volume element.

5. A system for detecting and imaging a chemical substance, comprising:

a particle source, the source generating a plurality of first subatomic particles and a plurality of second subatomic particles from a target position a first distance from the chemical substance, the first subatomic particles irradiating the chemical substance;

at least one photon detector capable of detecting photons resulting from the irradiation of the chemical substance by the first subatomic particles;

a particle detector array comprising a plurality of particle detectors, the particle detector array capable of detecting at least one second subatomic particle, the particle detector array at a second distance from the target position, the second distance larger than the first distance; and

an analyzer capable of detecting and imaging the chemical substance based on signals output from the at least one photon detector and the at least one particle detector.

6. The system of Claim 5, wherein the particle detectors are electronically coordinated to produce a three dimensional electronic image of the chemical substance, the image corresponding to a plurality of imaged volume elements, whereby the image provides an average empirical chemical formula for each imaged volume element.

7. The system of Claim 5, wherein the first subatomic particles comprise neutrons.

8. The system of Claim 7, wherein the neutrons have an energy level greater than or equal to 1 MeV.

9. The system of Claim 7, wherein the particle source comprises at least one target and at least one hydrogen isotope source which generates hydrogen isotopes, the particle source configured to impinge the hydrogen isotopes on the at least one target, thereby generating the neutrons.

10. The system of Claim 5, wherein the second subatomic particles comprise alpha particles.

11. The system of Claim 10, wherein the at least one photon detector and the at least one particle detector are adapted to provide information regarding the position of the chemical substance relative to the system.

12. The system of Claim 5, wherein the photon detector comprises a Germanium crystal detector capable of detecting gamma rays.

13. The system of Claim 5, wherein the plurality of particle detectors comprise at least one scintillation detector.

14. The system of Claim 5, wherein the analyzer is adapted to detect coincidences between the particle detector and the photon detector.

15. The system of Claim 14, wherein the coincidences correspond to a plurality of spectral lines and the analyzer is further adapted to electronically process the detected coincidences to provide discrimination among the spectral lines.

16. The system of Claim 14, wherein the analyzer is further adapted to provide information regarding ratios of types of constituent atoms present in the chemical substance.

17. The system of Claim 16, wherein the types of constituent atoms include carbon, nitrogen, and oxygen.

18. A method of detecting and imaging the presence of a chemical compound located within an object, the method comprising:

generating a plurality of pairs of particles from a target position spaced a first distance from the object, each pair of particles comprising a first particle and a second particle;

impinging the object with the plurality of first particles, the first particles interacting with nuclei of the chemical compound and the object to generate nuclear emissions from the chemical compound and the object;

detecting the plurality of second particles using a particle detector array comprising a plurality of particle detectors, the particle detector array spaced a second distance from the target position, the second distance larger than the first distance;

detecting the nuclear emissions from the chemical compound and the object;

processing the detected nuclear emissions to substantially eliminate a fraction of the nuclear emissions; and

detecting the chemical compound by analyzing the detected nuclear emissions which are not eliminated by the processing.

19. The method of Claim 18, wherein processing the detected nuclear emissions comprises using the first distance and the second distance to magnify a linear dimension of an image of the object as projected onto the particle detector array, the image magnified by a ratio of the second distance and the first distance.

20. The method of Claim 18, wherein the plurality of first particles comprises neutrons.

21. The method of Claim 18, wherein the plurality of second particles comprises alpha particles.

22. The method of Claim 18, wherein the nuclear emissions comprise a plurality of photons, the plurality of photons having a photon energy distribution.

23. The method of Claim 22, wherein processing the detected nuclear emissions comprises filtering the detected photons based on the photon energy distribution.

24. The method of Claim 23, wherein detecting the chemical compound comprises determining relative proportions of constituent atoms in the chemical compound by analyzing the photon energy distribution.

25. The method of Claim 24, wherein determining relative proportions of constituent atoms comprises determining relative proportions of carbon, nitrogen, and oxygen using a Dalitz triangle.